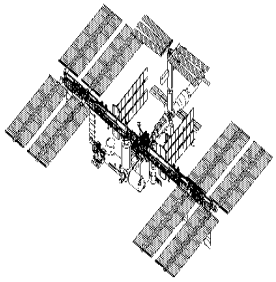
BOEING

International Space Station Program
Science and Utilization Segment

S683-35451
Prime Item Development Specification for the Payload Software Integration & Verification (PSIV) Capability

REV A, DRAFT 1



INTERNATIONAL
SPACE STATION

April 30, 1996

Submitted to: National Aeronautics and Space Administration
Marshall Space Flight Center
Contract No. NAS8-50000 (DR CM09)

S683-35451, REV A, DRAFT 1
CAGE CODE 3A768
30 APRIL 1996

Prime Item Development Specification for the Payload Software Integration & Verification Capability

Type B1

prepared for
National Aeronautics and Space Administration (NASA)
Huntsville, Alabama

by

Boeing Defense & Space Group
Missiles & Space Division
(a division of The Boeing Company)
Huntsville, Alabama

Authenticated by _____ **Approved by** _____

Dated _____ **Dated** _____

PRIME ITEM DEVELOPMENT SPECIFICATION FOR THE PAYLOAD SOFTWARE INTEGRATION AND VERIFICATION (PSIV) CAPABILITY

CONTRACT NO.: NAS8-50000
DR SEQUENCE NO.: OP21

30 April 1996

Prepared for:

Marshall Space Flight Center (MSFC)
S&U Program Office; Huntsville, AL

Prepared by:

Boeing Defense & Space Group, Missiles and Space Division
(a division of The Boeing Company)
Huntsville, Alabama

PREPARED BY:	Julie T. Graham	2-8K37	6/28/96
APPROVED BY:	Rick Scriven	2-8K37	6/28/96
QA:	Dean Goglin	2-4850	7/01/96
DQA:	Ken Hearn	2-8C26	7/02/96
CM:	Bill McElrath	2-8C26	7/11/96
	SIGNATURE	ORGN	DATE

INTERNATIONAL SPACE STATION PROGRAM
PRIME ITEM DEVELOPMENT SPECIFICATION FOR THE PAYLOAD SOFTWARE INTEGRATION AND VERIFICATION (PSIV) CABABILITY

Space Station Freedom Projects Office
Marshall Space Flight Center
Huntsville, Alabama

(This page intentionally left blank)

FORWARD

This specification is prepared in accordance with Contract NAS8-50000. This specification defines the Payload Software Integration and Verification Capability requirements.

(This page intentionally left blank)

SPECIFICATION CHANGE HISTORY

Specification No. S683-35451

SCN NO.	ECP No.	SCN Approval (SA No.)	SCN Approval Date	Specification Pages Affected	Serial Number Effectivity

REVISION HISTORY

Specification No. S683-35451, Rev A, Draft 1

Specification Revision/Date	ECPs/SCNs Incorporated	Serial Number Effectivity
Initial Release (31 March 1995)	PSV-002	
Rev A, Draft 1 (30 April 1996)	Released to NASA, MSFC for baselining per ECP BE01030 Incorporated Issues: IDR2-024 and IDR2-025 Updated Paragraphs: 3.7.1.2.5, 3.7.2.4.1, 3.7.2.4.3	

CONTENTS

CONTENTS (continued)

FIGURES

APPENDICES

1. SCOPE

1.1 Identification. This document is identified as the Payload Software Integration and Verification (PSIV) Prime Item Development Specification (PIDS), S683-35451.

1.2 System overview. The primary purpose of the PSIV capability is to integrate Space Station payload software with the Command & Data Handling (C&DH) system and to verify the interfaces between payload software and International Space Station Alpha (ISSA) system software that supports payload operations. This function includes the verification of the interface between the station and the Payload Developer Software (PDS) designed to execute in a Payload Experiment Developer (PED) processor. The PSIV capability will perform stand-alone and increment payload software integration and verification. The PSIV capability will also support the on-orbit resolution of payload flight software anomalies.

In order to accomplish the interface integration and verification process, the PSIV capability will develop, integrate, and verify Payload Application Software (PAS) and Payload Support Data (PSD) necessary to support specific increments. PAS is any payload unique software developed to perform specific data acquisition, data reduction, data processing, and data manipulation requirements for the complement of payloads on a given increment. PSD includes all of the payload data definitions, data files, displays, and procedures stored and/or executed in station avionics devices that are used to support the execution of PAS, PDS, Payload Executive Software (PES), EXPRESS Controller Software (ECS) or EXPRESS Pallet MDM Application Controller Software (EPMACS). The PSIV capability will also develop a Suitcase Test Environment for Payloads (STEP) to support PEDs in the development of their software and to support final payload interface verification conducted at the Payload Integration & Checkout Facility (PICF).

1.3 Document overview. The PSIV PIDS defines the requirements that must be satisfied to provide payload software integration and verification for all U.S. controlled payloads manifested in the ISSA. Figure 1 illustrates the requirements flow between the PSIV PIDS and parent Space Station ground documentation. This document specifies PSIV requirements which will be verified during PSIV acceptance testing, prior to the PSIV Operational Readiness Date (ORD).

Requirements in section 3.2.1 define the performance of the PSIV capability as a whole. Requirements in section 3.7 define the performance of each of the major components that comprise the PSIV capability.

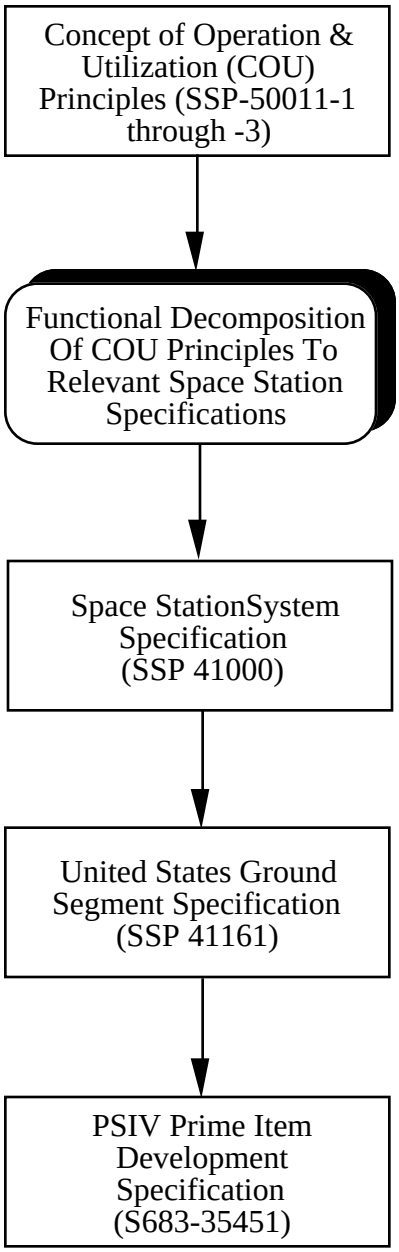


FIGURE 1 PSIV Capability Specification Tree

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the document referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS

Federal

Military

National Aeronautics and Space Administration (NASA)

NHB 2410.9	NASA Automated Information Security System Handbook
SSP 30540	Human Computer Interface Guide
SSP 30312	Electrical, Electronic, and Electromechanical Parts Management and Implementation Plan for the Space Station Program

STANDARDS

Federal

Military

MIL-STD-454	Standard General Requirements for Electrical Equipment
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

NASA

DRAWINGS

(Copies of specifications, standards, drawings, and publications required by suppliers in connections with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer).

OTHER PUBLICATIONS

2.2 Non-Government documents. This section is not applicable to this specification.

2.3 Reference documents. The following documents were used for information in deriving, or supporting, system requirements.

DOD-STD-2167	Defense System Software Development
MIL-STD-490	Specification Practices
MM 2700.HC	Safety and Environmental Health Standards

NASA-STD- 3000	Manned Systems Integration Standards
S683-70726	Lab Systems 1 Computer Software Configuration Item (CSCI) Software Requirements Specification (SRS)
S683-70727	Lab Systems 2 CSCI SRS
S683-70728	Lab Systems 3 CSCI SRS
S683-70729	Lab Systems 4 CSCI SRS
S683-70731	Internal Systems Multiplexer/Demultiplexer CSCI SRS

2.4 Parent Documentation. The requirements in the following document served as parents for the derived requirements that appear in this specification.

SSP 41161	United States Ground Segment Specification

3. PSIV REQUIREMENTS

3.1 Prime item definition. The PSIV capability will integrate and verify U.S. controlled payload software to assure payload interface and increment compatibility with the ISSA. This capability confirms proper payload to ISSA communications (commanding, monitoring, telemetry, etc.). The PSIV capability will develop, integrate, and verify increment dependent PAS and PSD resident in station provided processors required to support payload execution. The PSIV capability also supports the on-orbit resolution of payload flight software anomalies. The PSIV capability is composed of three major components: the PSIV Test Environment (PTE), the PSIV Software Development Environment (PSDE), and the Suitcase Test Environment for Payloads (STEP).

3.1.1 Prime item diagram. The PSIV capability prime item diagram is depicted in Figure 2.

3.1.2 Interface definition. This section describes the PSIV external and internal interface requirements. An external interface is any information transfer required between the PSIV capability and an external facility or Product Group (PG). An internal interface is any information transfer required between the major components of the PSIV capability.

3.1.2.1 External interface requirements. The following sections describe the interface requirements between the PSIV capability and external entities. Figure 3 illustrates the PSIV external interface diagram. The PSIV external interface diagram denotes the specific external facilities, systems, databases, and organizations that provide the functional or physical interface function. Interface Control Documents (ICDs) will be developed with some of the external facilities to define detailed interface requirements.

3.1.2.1.1 Payload Experiment Developer (PED)/Payload/Payload Simulation external interface description.

a. The PSIV capability shall accommodate PED provided Functional Equivalent Unit (FEU) processors, payload software simulations, and data necessary to support payload software verification.

b. The PSIV capability shall provide the appropriate flight equivalent data interfaces to support the operation of PED provided FEU's necessary for payload software integration and verification.

c. The PSIV capability shall provide the appropriate flight equivalent data interfaces to support the operation of PED provided payload software simulations necessary for payload software integration and verification.

d. The PSIV capability shall provide the flight equivalent data interfaces necessary for the verification of the functional interfaces between PED provided payload software and ISSA software.

e. The PSIV capability shall support remote testing of PED payload software interfaces for command and control and low and medium rate telemetry.

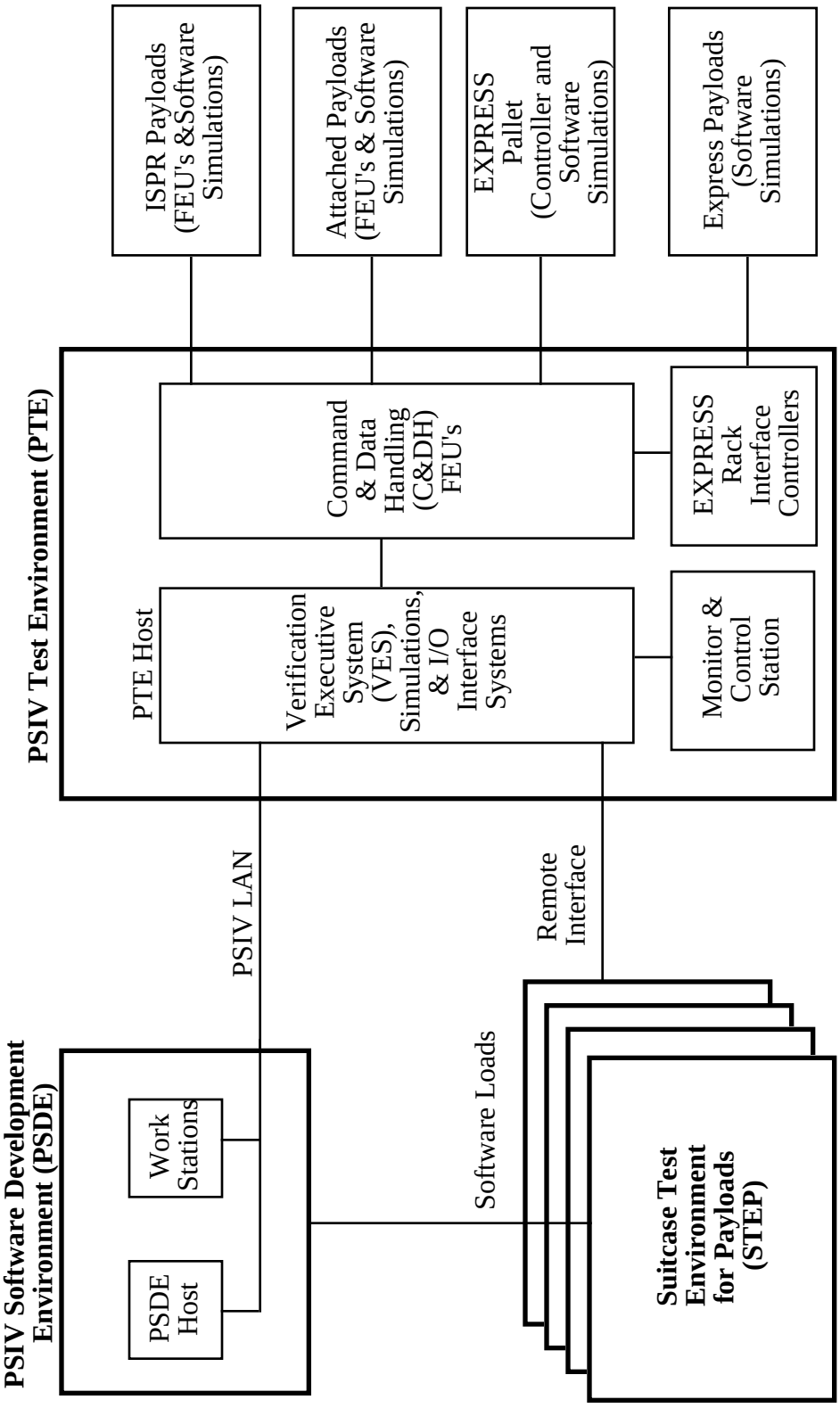


FIGURE 2 PSIV Prime Item Diagram

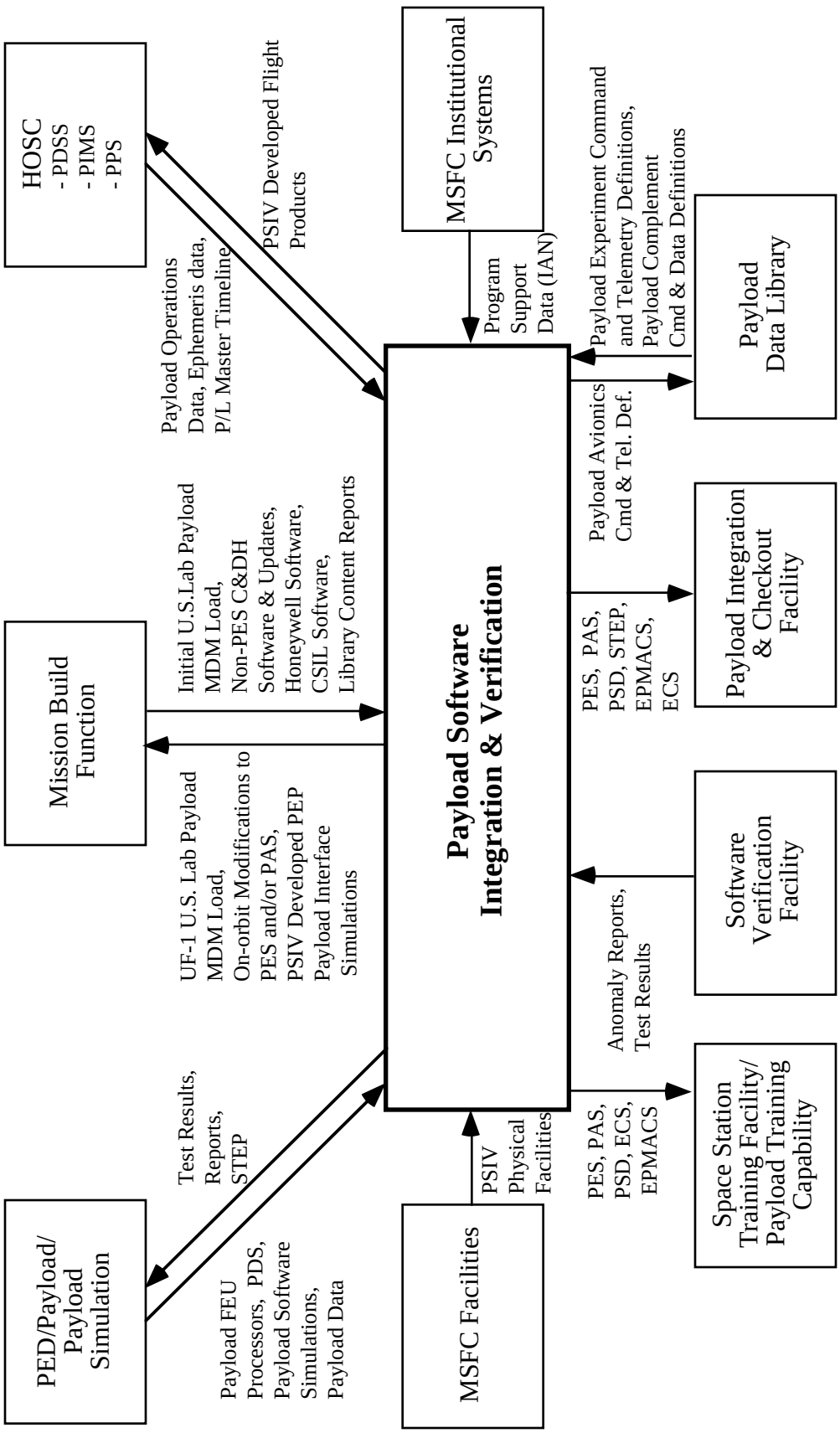


FIGURE 3 PSIV Capability External Interfaces

f. The PSIV capability shall interface with the PED to negotiate the use of a STEP to aid in the development of their payload flight software.

g. The PSIV capability shall provide test results or anomaly reports to the PED in support of payload software interface integration and verification tasks.

3.1.2.1.2 Huntsville Operations Support Center (HOSC) external interface description.

a. The PSIV capability shall interface with the HOSC for access to the Payload Information Management System (PIMS) applications, the Payload Data Services System (PDSS), and the Payload Planning System (PPS).

b. The PSIV capability shall interface with PIMS for the receipt of payload operations data required to support payload interface verification and integration.

c. The PSIV capability shall interface with PIMS to support verification of automated payload procedures.

d. The PSIV capability shall interface with PIMS for the transfer of PSIV developed flight products (PES, PAS, PSD, etc.) required for uplink to the ISSA.

e. The PSIV capability support a simulation interface with the PDSS to support the verification of pre-increment payload software updates.

f. The PSIV capability shall support a simulation interface with PDSS to support the verification of PSIV developed payload software updates resulting form payload operations replanning (i.e. updates to displays, automated payload procedures, data tables, etc. that will be uplinked to the ISSA by the POIC).

g. The PSIV capability shall interface with the PPS to receive Ephemeris data and payload master timelines via the PIMS planning system interface.

3.1.2.1.3 Payload Data Library (PDL) external interface description.

a. The PSIV capability shall interface with the PDL for the electronic receipt of payload experiment command definitions.

b. The PSIV capability shall interface with the PDL for the electronic receipt of payload experiment telemetry definitions.

c. The PSIV capability shall interface with the PDL to provide payload avionics command and data definitions to the POIC.

d. The PSIV capability shall interface with the PDL to receive payload complement command and data definitions.

3.1.2.1.4 Mission Build Facility (MBF) external interface description.

a. The PSIV capability shall interface with the MBF for the receipt of the initial U.S. Lab Payload MDM load and associated payload IP&CL data developed by PG-3.

b. The PSIV capability shall interface with the MBF for the receipt of non-PES related C&DH software and all subsequent updates (i.e. Timeliner, PCS software, Payload Ethernet Hub/Gateway (PEHG), etc.).

c. The PSIV capability shall interface with the MBF for the transfer of the U.S. Lab Payload MDM load and associated payload IP&CL data for UF-1 to support horizontal testing in the SVF.

d. The PSIV capability shall interface with the MBF for the transfer of the U.S. Lab Payload MDM load for subsequent UF missions, as required, to support horizontal testing at the SVF.

e. The PSIV capability shall interface with the MBF for the transfer of on-orbit modifications made to PAS that supports U.S. sponsored payloads not attached to the Payload Local Bus (i.e. payloads manifested in the APM) for horizontal testing at the SVF .

f. The PSIV capability shall interface with the MBF for the transfer of on-orbit modifications made to PES for horizontal testing at the SVF.

g. The PSIV shall interface with the MBF to receive software and data library content reports from the MBF.

h. The PSIV capability shall interface with the MBF for the transfer of PSIV developed PEP payload interface simulations (i.e. low fidelity payload data bus models to drive PES, PAS, etc.) necessary to support horizontal testing in the SVF.

3.1.2.1.5 Software Verification Facility (SVF) external interface description.

a. The PSIV capability shall interface with the SVF to receive test results and anomaly reports generated during horizontal testing upon request.

3.1.2.1.6 Marshall Space Flight Center (MSFC) institutional systems external interface description.

a. The PSIV capability shall interface to the MSFC Institutional Area Network (IAN) to support administrative network communications, the Program Support Communications Network/Internet(PSCNI), and the National Science Internet (NSI).

b. The PSIV capability shall interface to the MSFC IAN to support remote authorized access to the PSIV for the transfer of data to and from remote users.

3.1.2.1.7 MSFC facility external interface description.

a. The PSIV capability shall receive all physical resources necessary to support the integration and verification of payload software from MSFC facilities.

3.1.2.1.8 Payload Integration & Checkout Facility external interface description.

a. The PSIV capability shall interface with the PICF for the transfer of PAS, PSD, PES, ECS, and EPMACS necessary to support final interface verification test.

b. The PSIV capability shall interface with the PICF for the delivery of a STEP to support final payload interface verification.

c. The PSIV capability shall interface with the PICF to support the remote STEP capability which supports final payload interface verification.

3.1.2.1.9 Space Station Training Facility/Payload Training Capability (SSTF/PTC) external interface description.

a. The PSIV capability shall interface with the SSTF/PTC for the transfer of PAS, PSD, PES, ECS, and EPMACS necessary to support flight crew training.

3.1.2.2 Internal interfaces The PSIV internal interfaces are defined in the following sections. Figure 2 above illustrates the internal interfaces between the PSIV major components.

3.1.2.2.1 PSDE internal interface description.

a. The PSDE shall transmit data and test session loads to the PTE for execution during integration and verification testing.

b. The PSDE shall receive test session logged data and results from the PTE for final test session data analysis.

c. The PSDE shall transfer software loads to the STEP as necessary to support payload software interface verification at the PED site and final payload interface verification at the PICF.

3.1.3 Major component list.

The major components of the PSIV capability are defined as follows:

a. PSIV Test Environment (Reference section 3.7.1)
b. PSIV Software Development Environment (Reference section 3.7.2)
c. Suitcase Test Environment for Payloads (Reference section 3.7.3).

3.1.4 Government furnished property list.

a. The PSIV capability shall utilize the items defined on the GFP List, Attachment J-9 of contract NAS8-50000.

3.1.5 Government loaned property list. This section is not applicable to this specification.

3.2 Characteristics.

3.2.1 Performance. The performance characteristics of the PSIV capability are provided in this section.

3.2.1.1 General.

a. The PSIV capability shall provide an ISSA command and data interface compatible environment that allows the integration and verification of flight software and data products required to support payload execution including those executing in the Payload Executive Processor (PEP), the payload Mass Storage Device (MSD), the Portable Computer System (PCS), the EXPRESS Rack Interface Controller (RIC), and the EXPRESS Pallet MDM Application Controller.

b. The PSIV capability shall provide an ISSA compatible development environment necessary to support the production of PSD and PAS.

c. The PSIV capability shall provide a development environment to produce PSIV operational software and hardware products.

d. The PSIV capability shall provide stand-alone payload software interface integration and verification testing.

e. The PSIV capability shall provide flight increment payload software interface integration and verification testing.

f. The PSIV architecture shall accommodate PED provided payload FEU's.

g. The PSIV capability shall support on-orbit payload anomaly resolution and testing.

h. The PSIV capability shall support payload software integration and verification tasks for multiple increments.

3.2.1.2 PSIV States. The PSIV capability functions in four states: Initialization, Operation, Termination and Reconfiguration. Figure 4 contains the PSIV State Transition Diagram which illustrates the relationships between the states. The subsequent sections contain requirements which describe the PSIV states.

3.2.1.2.1 Initialization State. The initialization state of the PSIV capability involves initiating a session for verification. This process consists of two phases, cold start to host ready and host ready to session load ready. The cold start to host ready phase includes power on for electrical components and computer equipment. The host ready to session load ready phase includes the verification of facility configuration and the loading of software for a specific verification session.

a. The PSIV capability shall be designed to support an orderly sequence for powering up the electrical components necessary to support test session initialization.

b. The test session initialization process from cold start to host ready shall be possible from the Verification Executive System (VES) operator terminal.

c. The test session initialization process from host ready to session load ready shall be performed from the Monitor & Control Station (MCS).

d. The test session initialization process shall allow initialization to a previously defined configuration file.

3.2.1.2.2 Operation State. The operation state of the PSIV capability is the state in which payload software verification is conducted. During the operation state, test personnel control the execution of system and payload models and verification session data is collected.

a. The operation process of the PSIV capability shall support PES, PSD, PAS, PDS, ECS, and EPMACS verification independent of real-time ISSA operations.

b. The operation process of the PSIV capability shall be controlled and monitored from the MCS and the PCS.

c. The operation process of the PSIV capability shall support the integration and verification of individual payloads.

d. The operation process of the PSIV capability shall support the integration and verification of a complete increment of payloads.

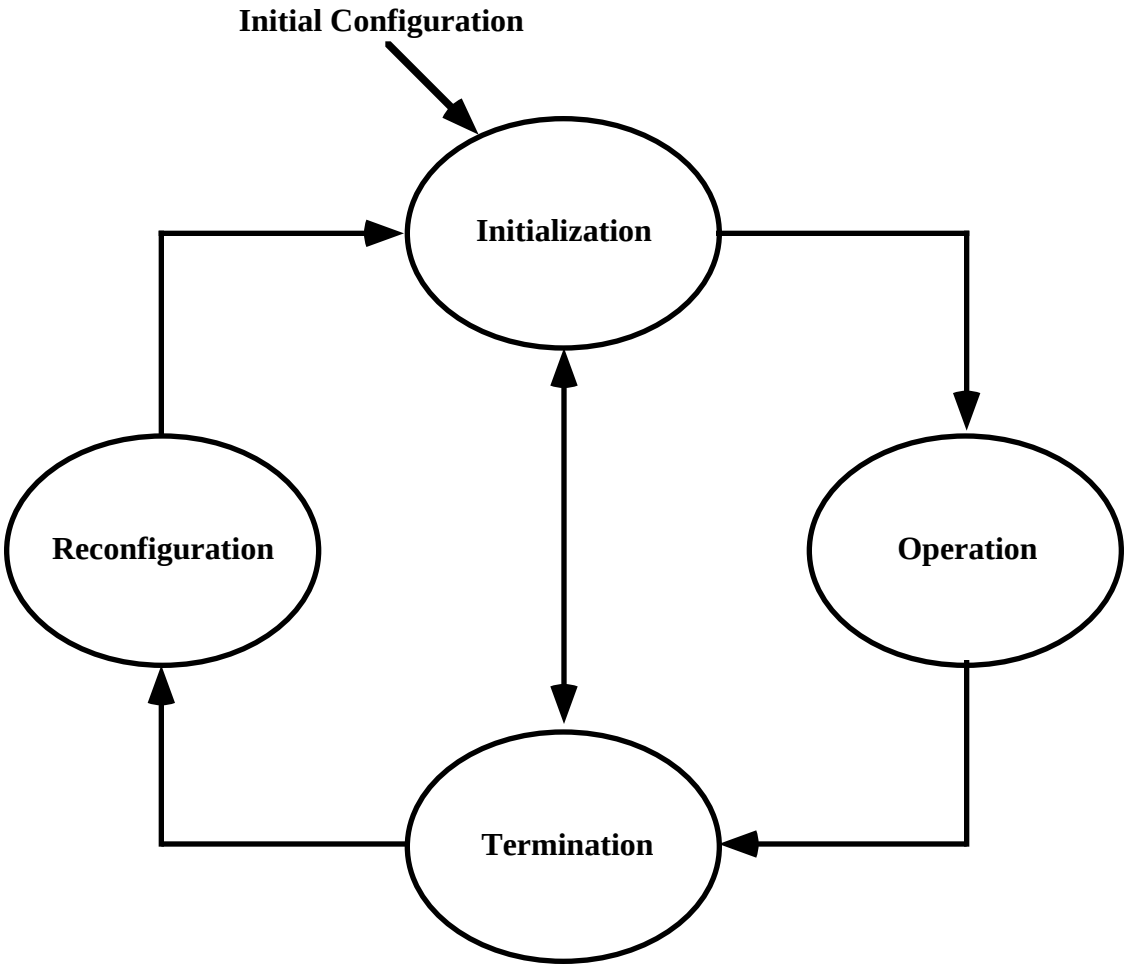


FIGURE 4 PSIV Capability State Transition Diagram

e. The operation process of the PSIV capability shall support the verification of increment changes to PES, PSD, PAS, PDS, ECS, and EPMACS as required.

f. The operation process of the PSIV capability shall support the real-time trouble-shooting and resolution of anomalies during onboard payload operations, including the verification of PSD and other flight software as required.

g. The operation process of the PSIV capability shall support the verification of automated payload procedures.

h. The operation process of the PSIV capability shall support the provision of integration and verification data to the PEDs during a test session.

3.2.1.2.3 Termination State. The termination state of the PSIV capability includes the process of completing and stopping a verification session. The termination state includes saving the appropriate verification session data, performing an orderly termination of the system and payload software, and if desired, performing an equipment shutdown. The termination state does support a direct transition to the initialization state to support software only reconfiguration tasks without performing equipment shutdown.

a. The termination process of the PSIV capability shall support an orderly sequence of powering down the electrical components necessary to support an integration or verification session.

b. The termination process of a test session shall be controlled by a test conductor from the MCS.

c. The termination process of the PSIV capability shall provide the capability to save integration or verification data for a defined configuration.

d. The termination process of the PSIV capability shall provide test session termination status to the test conductor.

e. The termination process of the PSIV capability shall support an orderly test session termination.

3.2.1.2.4 Reconfiguration state. The reconfiguration state of the PSIV capability involves the removal and replacement of payload components prior to an integration or verification session to support different payload configurations. Reconfiguration may involve hardware and/or software reconfiguration to meet the needs for a particular integration or verification session.

a. The reconfiguration process of the PSIV capability shall support reconfiguration of integration and verification hardware prior to initiating a test session.

b. The reconfiguration process of the PSIV capability shall support reconfiguration of integration and verification software loads prior to initiating a test session.

c. The reconfiguration process of the PSIV capability shall accommodate reconfiguration tasks by allowing removal and installation of payload FEUs from the PTE.

3.2.2 Physical characteristics. This section is not applicable to this specification.

3.2.3 Reliability.

a. The PTE shall be designed such that failure of one payload simulation model in an individual integration or verification session will not cause failure of any other payload simulation models in that integration or verification session.

3.2.4 Maintainability. This section is not applicable to this specification.

3.2.5 Environmental conditions.

a. All PSIV equipment shall operate over a temperature range of 60 degrees Fahrenheit (F) to 80 degrees F.

b. All PSIV equipment shall operate over a relative humidity range of 20% to 80%, non-condensing.

c. Electrostatic protection shall be provided for all sensitive computer equipment.

3.2.6 Transportability. This section is not applicable to this specification.

3.2.7 Flexibility and expansion.

a. The PSIV capability shall be designed in a modular fashion to facilitate changes and upgrades.

3.3 Design and construction.

3.3.1 Materials, processes, and parts.

a. The components of the PSIV capability shall utilize standard parts in preference to non-standard or uncommon parts in their design and construction.

b. Electrostatic discharge shall be controlled per SSP 30312, Appendix B.

3.3.1.1 Toxic products and formulations. This section is not applicable to this specification.

3.3.2 Electromagnetic radiation.

a. The PSIV capability shall be designed to be electromagnetically compatible with itself and its environment.

3.3.3 Nameplates and product marking.

a. The hardware, equipment, and major parts of the PSIV capability shall be marked for information and identification.

3.3.4 Workmanship.

a. All components used to support the PSIV capability including the finished equipment shall be free from any defects which may affect their serviceability or appearance.

b. Electrical equipment used to support the PSIV capability that is not Commercial Off The Shelf (COTS) shall be manufactured, assembled, and mounted or installed as specified in MIL-STD-454.

3.3.5 Interchangeability.

a. The design of the PSIV capability shall maximize the use of interchangeable items between its major components.

3.3.6 Safety.

a. The PSIV design shall apply system safety engineering principles in the design, development, installation, and test of the PSIV capability.

3.3.7 Human performance/human engineering.

a. The PSIV design shall meet the intent of the human engineering principles and criteria provided in SSP 30540 (Human Computer Interface Guide) and MIL-STD-1472 (Human Engineering Design Criteria for Military Systems, Equipment, and Facilities).

3.3.8 System security.

a. The PSIV capability shall be in compliance with the rules set forth by NASA Automated Information Security (AIS) System level 2 security excluding encryption defined in NHB 2410.9.

3.4 Documentation.

a. PSIV documentation shall include all hardware, software, (including COTS items and any associated modifications) and processes necessary to maintain, operate, and repair PSIV equipment.

b. Electronic documentation media, whenever available, shall be employed to document the design, operations, test, and maintenance of the PSIV capability.

3.5 Logistics.

3.5.1 Maintenance.

a. The PSIV design shall ensure that maintenance of PSIV equipment is possible by defective part removal and replacement, repair, service or modification.

b. The PSIV design shall ensure that equipment removal and replacement can be accomplished by one person where permitted by structural, functional and weight limitations.

3.5.2 Supply.

a. The PSIV capability shall provide for replacement, repair, service, and modification of the PSIV hardware.

3.5.3 Facilities and facility equipment.

3.5.3.1 General.

a. The PSIV capability shall be located on site at MSFC.

b. The MSFC facility shall be physically secured.

c. The MSFC facility shall provide keycard access to authorized personnel only.

d. The MSFC facility shall provide a security system that protects PSIV equipment and company proprietary information contained within the structure.

e. The MSFC facility shall provide a security system that restricts access to all areas defined as sensitive.

f. The MSFC facility shall utilize cable routing and ducting services that do not obstruct free movement of personnel or equipment throughout the facility.

g. The MSFC facility shall provide clearance for safe access to equipment during operations and maintenance.

h. The MSFC facility shall provide audio and video networks to support MSFC Private Automatic Branch Exchange (PABX), Early Warning System (EWS), and MSFC Closed Circuit Television (CCTV) network including NASA SELECT communications.

3.5.3.1.1 Lighting.

a. The MSFC facility shall provide standard office lighting in all PSIV areas except where requirements for specific areas specify differently.

b. The MSFC facility areas shall have emergency lighting in case of power failures.

3.5.3.1.2 Electrical power.

a. The MSFC facility shall provide 208 Volts Alternating Current (VAC) three phase electrical power service where necessary.

b. The MSFC facility shall provide 120 VAC electrical power service within the PSIV facility.

c. The MSFC facility shall provide the electrical power necessary to operate all PSIV systems simultaneously.

d. The MSFC facility shall provide conditioned power to prevent damage to PSIV equipment from severe power fluctuations and transients.

e. The MSFC facility shall provide the appropriate grounding for all PSIV electrical equipment.

f. The MSFC facility shall provide an emergency power cut-off switch for all MSFC facility power to the PSIV equipment.

3.5.3.1.3 Heating, ventilation, and air conditioning.

a. The MSFC facility shall provide a Heating, Ventilation, and Air Conditioning (HVAC) system that maintains ambient air in all MSFC facility areas within the effective temperature range of 73 ±5 degrees F.

3.5.3.1.4 Fire detection and suppression.

a. The MSFC facility shall provide a fire detection and suppression system in the PSIV areas.

3.5.3.2 Receiving area.

a. The MSFC facility shall provide a receiving area.

b. The receiving area shall be sized to accommodate a full increment of payload models.

c. The receiving area shall be located such that equipment transportation to support the PSIV capability is possible with standard shop equipment (hand trucks, carts, etc.).

3.5.3.3 PED work area.

a. The MSFC facility shall provide TBD work areas to support a total of TBD payload experiment developer personnel.

b. The MSFC facility shall provide the means for PEDs to verify the proper operation of their payload FEUs prior to performance of a test session in the PTE.

3.5.3.4 Management Information Center (MIC).

a. The MSFC facility shall provide a MIC conference room with audio visual equipment (i.e.: speaker phone, overhead projector, etc.).

3.6 Personnel and training.

a. The PSIV capability shall provide training materials on the operation and utilization of the STEP.

3.7 Major component characteristics.

3.7.1 PSIV Test Environment. The requirements in this section represent the capabilities to be provided by the PTE. The PTE utilizes a combination of equipment and software to simulate the ISSA software with respect to payloads and provide additional capabilities to control and monitor a verification session. The PTE will verify that each payload's software interfaces correctly with the ISSA. The PTE will also confirm that a complete increment of payloads interacts with each other and the station as expected. The PTE is composed of simulations, simulators, the MCS, the VES, and the data logging function.

3.7.1.1 General.

a. The PTE shall provide stand-alone and full increment payload interface verification for U.S. C&DH controlled payload software.

b. The PTE shall be capable of executing multiple individual payload simulations simultaneously without regard for the constraints of the flight operating envelope.

c. The PTE shall support software execution at rates equivalent to ISSA real time rates.

d. The PTE shall simulate the execution of payload timelines.

e. The PTE shall allow the interjection of flight crew and ground controller commands.

f. The PTE shall simulate the ISSA systems and environment as required to support payload software integration and verification with the C&DH system.

g. The PTE shall provide payload software interface verification for payload to payload interactions.

h. The PTE shall provide payload software interface verification for all U.S. controlled payloads interfacing to the station Payload Multiplexer/Demultiplexer (MDM).

i. The PTE shall provide payload software interface verification for EXPRESS payloads.

j. The PTE shall provide payload software interface verification for EXPRESS Pallet payloads.

k. The PTE shall provide payload software interface verification for attached payloads.

l. The PTE shall be capable of operating the verification session through execution of test scripts.

m. The PTE shall be capable of executing payload flight software designed for execution in the Payload MDM.

n. The PTE shall be capable of executing payload flight software designed for execution in the EXPRESS RIC.

o. The PTE shall be capable of executing payload flight software designed for execution in the EXPRESS Pallet MDM Application Controller.

p. The PTE shall provide a pause/resume capability to the extent that this capability is supported by the C&DH simulator utilized in the PTE.

q. The PTE shall be capable of executing a subset of an increment of payload software.

r. The PTE shall provide the capability to verify payload software interfaces to the C&DH system.

s. The PTE shall be able to support integration and testing of payload software configuration data.

t. The PTE shall be designed to accommodate functionally equivalent payload computational equipment.

u. The PTE shall provide for the execution of automated procedures.

v. The PTE shall be reconfigurable to support on-orbit payload anomaly resolution.

w. The PTE shall be capable of executing payload flight software designed for execution in the PCS.

3.7.1.2 Simulations. The simulations utilized in the PTE will be composed of PSIV developed software only simulations of the ISSA environment which are necessary to support payload interface integration and verification sessions. Interface simulations will also be developed to allow communication between PSIV developed software and PED provided software. The PTE simulations include: the ISSA system simulation, the payload interface simulation, and the RIC interface simulation.

a. The simulations shall provide the interfaces to the C&DH simulator that are necessary to support payload software integration and verification.

b. The simulations shall be controllable from the MCS.

c. The simulations shall support data overrides by the MCS.

d. The simulations shall provide the data required for PCS displays and MCS displays.

e. The simulations shall make data available for logging.

f. The simulations shall support initialization to a predefined condition.

3.7.1.2.1 ISSA system simulation.

a. The ISSA system simulation shall simulate onboard systems with interaction to payloads (via the payload MDM), including ancillary data.

b. The ISSA system simulation shall provide simulated health and status data (i.e., state vector, sensor status, etc.) in accordance with the corresponding flight system.

c. The ISSA system simulation shall acknowledge the receipt of Tier 1 commands in accordance with the corresponding flight system.

d. The ISSA system simulation shall be capable of interfacing to PDS and payload software models via the payload MDM.

e. The ISSA system simulation shall be capable of interfacing to other ISSA system simulations.

f. The ISSA system simulation shall duplicate the C&C MDM functionality as necessary for payload software integration and verification.

g. The ISSA system simulation shall verify that payload health and status telemetry data is formatted in the Consultant Committee for Space Data Systems (CCSDS) packet format.

h. The ISSA system simulation shall be capable of depacketizing CCSDS packets.

i. The ISSA system simulation shall be capable of deciphering payload local bus messages to determine data contents.

j. The ISSA system simulation shall retrieve individual health and status parameters from the CCSDS packets.

k. The ISSA system simulation shall simulate the management of Communication & Tracking (C&T) resources and provide for C&T data distribution.

l. The ISSA system simulation shall simulate the Global Positioning System (GPS) function to support payload integration and verification.

m. The ISSA system simulation shall simulate environmental data as necessary for payload software integration and verification.

3.7.1.2.2 Payload interface simulation.

a. The payload interface simulation shall provide a mechanism for integration of payload simulations into the VES environment.

b. The payload interface simulation shall execute within the VES environment.

c. The payload interface simulation shall provide a simple mechanism for adding or deleting payload simulations to/from the complement of simulations running in the VES environment during the reconfiguration state.

d. The payload interface simulation shall provide a simple mechanism for specifying the data requirements (commands, status data items) received and supplied by a payload simulator.

e. The payload interface simulation shall provide payload data for MCS and PCS displays.

f. The payload interface simulation shall distribute commands to the payload simulators.

g. The payload interface simulation shall provide an interface for payloads to request station resources.

h. The payload interface simulation shall provide an interface for payloads to request Payload MDM services.

i. The payload interface simulation shall provide an interface for payloads to communicate with other simulations running in the VES environment.

j. The payload interface simulation shall support payload developer-provided FEUs and simulations connected to the Payload MDM.

3.7.1.2.3 RIC interface simulation.

a. The RIC interface simulation shall provide a mechanism for integration of EXPRESS RIC simulations into the VES environment.

b. The RIC interface simulation shall execute within the VES environment.

c. The RIC interface simulation shall provide a simple mechanism for adding or deleting RIC simulations to/from the complement of simulations running in the VES environment during the reconfiguration state.

d. The RIC interface simulation shall provide a simple mechanism for changing the configuration data of a RIC simulation running in the VES environment.

e. The RIC interface simulation shall provide predefined RIC data (including payload data passed through the RIC) for MCS and PCS displays.

f. The RIC interface simulation shall distribute tester-generated commands to RIC simulators (for their associated payloads).

g. The RIC interface simulation shall provide an interface for RIC simulations to request Payload MDM services on behalf of their associated payloads.

h. The RIC interface simulation shall provide an interface for the RIC simulation to communicate with other simulations running in the VES environment.

i. The RIC interface simulation shall provide EXPRESS hardware resources and software services necessary to support the EXPRESS payload software.

j. The RIC interface simulation shall support a RIC FEU or simulation.

k. The RIC interface simulation shall support payload developer provided FEUs and simulations for payloads with any EXPRESS connectivity option.

3.7.1.2.4 EXPRESS Pallet MDM Application Controller Interface Simulation.

a. The EXPRESS Pallet MDM Application Controller interface simulation shall provide a mechanism for integration of EXPRESS Pallet Controller MDM simulations into the VES environment.

b. The EXPRESS Pallet MDM Application Controller interface simulation shall execute within the VES environment.

c. The EXPRESS Pallet MDM Application Controller interface simulation shall provide a simple mechanism for adding or deleting EXPRESS pallet simulations to/from the complement of simulations running in the VES environment during the reconfiguration state.

d. The EXPRESS Pallet MDM Application Controller interface simulation shall provide a simple mechanism for changing the configuration data of a EXPRESS pallet simulation running in the VES environment.

e. The EXPRESS Pallet MDM Application Controller interface simulation shall provide predefined Controller MDM data (including payload data passed through the RIC) for MCS displays.

f. The EXPRESS Pallet MDM Application Controller interface simulation shall distribute tester-generated commands to EXPRESS pallet simulators (for their associated payloads).

g. The EXPRESS Pallet MDM Application Controller interface simulation shall provide an interface for EXPRESS pallet simulations to request Payload MDM services on behalf of their associated payloads.

h. The EXPRESS Pallet MDM Application Controller interface simulation shall provide an interface for the EXPRESS pallet simulation to communicate with other simulations running in the VES environment.

i. The EXPRESS Pallet MDM Application Controller interface simulation shall provide EXPRESS hardware resources and software services necessary to support the EXPRESS pallet payload software.

j. The EXPRESS Pallet MDM Application Controller interface simulation shall support an EXPRESS Pallet FEU or simulation.

k. The EXPRESS pallet MDM Application Controller interface simulation shall support payload developer provided FEUs and simulations for payload with an EXPRESS Pallet connectivity option.

3.7.1.2.5 International Partner (IP) module payload interface simulation. The IP module payload interface simulation supports the integration and verification of U.S. controlled payloads manifested in the IP modules.

a. The IP module payload interface simulation shall simulate the transfer of ISPR data between the IP modules and the C&C MDM.

b. The IP module payload interface simulation shall provide a mechanism for integration of payload simulations into the VES environment.

c. The IP module payload interface simulation shall execute within the VES environment.

d. The IP module payload interface simulation shall provide a mechanism for adding or deleting payload simulations to/from the complement of simulations running in the VES environment during the reconfiguration state.

e. The IP module payload interface simulation shall provide a mechanism for specifying the data requirements (commands, status data items) received and supplied by a payload simulator.

f. The IP module payload interface simulation shall provide payload data for MCS and PCS displays.

g. The IP module payload interface simulation shall distribute commands to the payload simulators.

h. The IP module payload interface simulation shall provide an interface for payloads to request station resources.

i. The IP module payload interface simulation shall provide an interface for payloads to request Payload MDM services.

j. The IP module payload interface simulation shall provide an interface for payloads to communicate with other simulations running in the VES environment.

3.7.1.3 Simulators. The simulators utilized in the PTE will be composed of hardware components and PSIV developed software products which are necessary to support payload interface integration and verification sessions. The PTE simulators include the C&DH simulator and the generic experiment simulator.

3.7.1.3.1 C&DH simulator.

a. The C&DH simulator shall provide C&DH hardware resources and software services necessary to support the data processing and communication needs of payload software.

b. The C&DH simulator shall provide resources and services to both International Standard Payload Rack (ISPR) based payloads, EXPRESS based payloads, EXPRESS Pallet Payloads, and attached payloads.

c. The C&DH simulator shall allow the initialization process of payload software to be controlled and monitored from the PCS.

d. The C&DH simulator shall allow payload software to be controlled and monitored from the MCS for the simulation of ground commands to a payload.

e. The C&DH simulator shall provide the PCS with all connectivity options.

f. The C&DH simulator shall provide the capability to transmit and receive data between real and simulated elements of the PSIV architecture.

g. The C&DH simulator shall execute flight software that executes on board in the payload MDM, and the PCS.

h. The C&DH simulator shall support the use of PSD.

i. The C&DH simulator shall be capable of providing the data necessary to refresh PCS display screens at flight rates.

3.7.1.3.2 Generic Experiment Simulator.

a. The generic experiment simulator shall have the capability to utilize all interfaces available to payloads.

b. The generic experiment simulator shall interface with the VES.

c. The generic experiment simulator shall be capable of exercising each ISSA system simulation to payload software interface provided in the PTE.

d. The generic experiment simulator shall be capable of exercising each payload interface simulation to payload software interface provided in the PTE.

e. The generic experiment simulator shall be capable of exercising each RIC interface simulation to payload software interface provided in the PTE.

f. The generic experiment simulator shall be capable of exercising each EXPRESS Pallet MDM Application Controller interface simulation to payload software interface provided in the PTE.

g. The generic experiment simulator shall provide simulated payload health and status data for display on the PCS and the MCS.

h. The generic experiment simulator shall be configurable to simulate multiple payloads concurrently, limited only by PTE resources.

3.7.1.4 Monitor & Control Station.

a. The MCS shall be capable of controlling and monitoring a verification session.

b. The MCS shall be capable of executing color text, graphics, and X-window displays.

c. The MCS shall be capable of displaying simulated Greenwich Mean Time (GMT), simulated Mission Elapsed Time (MET), and local time.

d. The MCS shall provide the capability to input and display Tier I commands.

e. The MCS shall provide the capability to display system and payload status data.

f. The MCS shall provide the capability to output selected data and graphics displays to a printer.

g. The MCS shall provide the capability to insert anomalies.

3.7.1.4.1 MCS services software. MCS services software will provide services for interaction with the MCS, generation of simulated ground commands, and the execution of scripts. It provides a standard interface to application software executing in the host computer for displaying data on predefined MCS displays and for receiving MCS operator inputs from the MCS.

a. The MCS services software shall provide the capability for the MCS operator to select a predefined session configuration for execution.

3.7.1.4.1.1 MCS support software.

a. The MCS support software shall provide the capability for the MCS operator to sign on at the MCS.

b. The MCS support software shall provide the MCS operator with a notification at the MCS of attempted sign-on success or failure.

c. The MCS support software shall provide the MCS operator the capability to sign-off from the MCS.

d. The MCS support software shall route MCS commands to the VES.

e. The MCS support software shall provide a standard mechanism to applications executing in the PTE for output of data to application-defined MCS displays.

f. The MCS support software shall provide a standard mechanism to applications executing in the PTE for receipt of commands and data from application-defined MCS displays.

3.7.1.4.2 Test script execution. The test script execution function will allow the MCS operator to control and monitor test script execution during a session.

a. The test script execution function shall provide the capability to execute a predefined set of scripts for initialization, operation, and termination of a specific session.

b. The test script execution function shall provide the capability for the test conductor to initiate, abort, pause, and resume scripts from the MCS.

c. The test script execution function shall provide status of the execution of scripts to the MCS operator.

d. The test script execution function shall provide the capability to initiate script actions based on the simulation time.

e. The test script execution function shall provide the capability to evaluate a specified logical expression to determine whether an action should be initiated.

f. The test script execution function shall provide the capability to execute script commands which control the sequence of script command execution.

g. The test script execution function shall provide the capability to delay initiation of an individual action until occurrence of a specified event.

h. The test script execution function shall interface via application services with applications executing on the host computer.

i. The test script execution function shall accommodate the control of simulation states.

j. The test script execution function shall provide the capability to initiate script actions based on a delta time from the previous script action.

3.7.1.4.3 Ground Command Generation. The ground command generation function will allow the test conductor to build and transmit simulated ground commands. Ground commands include POIC commands as well as user operation facility commands.

a. The ground command generation function shall provide the test conductor the capability to interactively insert simulated ground commands during a session.

b. The ground command generation function shall allow the test conductor to transmit simulated ground commands to the C&DH simulator.

c. The ground command generation function shall allow the test conductor to select ground commands from a predefined set of simulated ground commands.

3.7.1.5 Verification Executive System.

a. The VES shall be capable of running all real time simulations including control, monitoring, and operational support functions.

b. The VES shall provide the capability to execute an integrated set of PSIV operational software and payload models.

c. The VES shall provide the capability to execute different software models at their respective fidelities.

d. The VES shall execute payload models at rates required to duplicate flight system payload data characteristics.

e. The VES shall support logging of selected verification results.

f. The VES shall perform test session data initialization based on a predefined simulation configuration.

3.7.1.5.1 Executive Services.

3.7.1.5.1.1 Session Control and Monitoring.

a. The session control and monitoring software shall control the initialization, operation, and termination of simulator software.

b. The session control and monitoring software shall provide initialization status and termination status to the MCS operator.

c. The session control and monitoring software shall control and monitor real-time execution of simulations and FEU hardware at cycles of up to 40 Hertz (Hz) during session operations.

d. The session control and monitoring software shall be capable of enabling and disabling individual simulators during session operations.

e. The session control and monitoring software shall be capable of reinitializing individual simulators without terminating and reinitializing the session.

f. The session control and monitoring software shall provide the capability to terminate the session via a command from the MCS or a host computer application.

g. The session control and monitoring software shall support an orderly session termination process.

h. The session control and monitoring software shall support the receipt of files including host session loads from the PSDE while in the host ready state.

i. The session control and monitoring software shall support the transmission of files including session logged data to the PSDE while in the host ready state.

3.7.1.5.2 Application services.

3.7.1.5.2.1 Data interface services. The data interface services will provide a standard set of services for use by all VES applications in manipulating simulation data.

a. The data interface services shall provide services to VES applications for reading and writing simulation data.

b. The data interface services shall provide communication among host computer based software.

c. The data interface services shall make simulation data available to the VES data logging capability.

d. The data interface services shall support event monitoring and notification of VES applications upon update of specified data variables.

e. The data interface services shall provide the mechanism to exclusively lock any simulation data defined for the session, preventing updates from any other source until the lock has been removed.

3.7.1.5.2.2 Input/Output (I/O) system services. The I/O system services will provide a standard set of services for use by all VES applications in communicating with hardware attached to the I/O system.

a. The I/O system services shall provide control and monitoring of real-time I/O data flow.

b. The I/O system services shall initialize the I/O system hardware to the configuration specified for the session.

c. The I/O system services shall transfer commands and data between host computer applications and equipment connected to the I/O system hardware.

d. The I/O system services shall provide the mapping of simulation data objects to the associated I/O channel destination.

e. The I/O system services shall provide status of data transfers between the host computer and the I/O system hardware.

f. The I/O system services shall provide mechanisms for transfer of discrete, analog, serial, and parallel data types.

3.7.1.6 Data logging. The data logging function will provide a means of collecting integration and verification session data to be used later in the PSDE to analyze session results.

a. The data logging function shall provide the capability to log script-initiated commands.

b. The data logging function shall provide the capability to log test conductor inputs from and outputs to the MCS.

c. The data logging function shall provide the capability to log simulated C&DH bus data.

d. The data logging function shall provide the capability to log control/configuration data.

e. The data logging function shall utilize a data logging specification previously defined as part of the session load, if provided.

f. The data logging function shall log data during the session utilizing pre-specified data logging parameters.

g. The data logging function shall time-tag data as it is being collected.

h. The data logging function shall provide data logging status to the MCS.

i. The data logging function shall provide time-tagging of data values with a TBD millisecond accuracy from the receipt of the data.

j. The data logging function shall support data specification modifications during real time operations.

k. The data logging function shall provide the capability to log simulation data.

3.7.2 PSIV Software Development Environment (PSDE). The PSDE provides the computational resources and tools required to support the development, updating, modification and maintenance of increment independent software and hardware drawings and payload software. PSDE functions include increment independent software development, increment independent hardware development, payload software development, session preparation, generic experiment simulator builder, session analysis, and Configuration Management (CM).

3.7.2.1 PSIV increment independent software development.

a. The PSIV increment independent software development function shall provide requirements analysis capabilities.

b. The PSIV increment independent software development function shall provide design capabilities.

c. The PSIV increment independent software development function shall provide implementation coding capabilities.

d. The PSIV increment independent software development function shall support software unit and integration testing.

e. The PSIV increment independent software development function shall provide documentation development tools.

f. The PSIV increment independent software development function shall provide the capability to create, modify, and maintain color text, graphics, and X-windows displays.

g. The PSIV increment independent software development function shall support the sustaining engineering of PSIV increment independent software.

3.7.2.2 PSIV increment independent hardware development.

a. The PSIV increment independent hardware development function shall support the development of PSIV hardware drawings.

b. The PSIV increment independent hardware development function shall support the sustaining engineering of PSIV hardware drawings.

3.7.2.3 Payload software development. The PSIV provides the computational resources and tools required to support development, updating, modification, and maintenance of PSD, PAS, and simulations to support horizontal testing. The PSIV also provides the computational resources and tools required to support the modification and maintenance of PES, RIC software and EXPRESS Pallet Controller software.

3.7.2.3.1 PSD development.

a. The PSD development function shall support the development, modification, and maintenance of Payload MDM configuration data tables.

b. The PSD development function shall support the development, modification, and maintenance of Payload MSD definition files.

c. The PSD development function shall support the development, modification, and maintenance of RIC configuration data tables.

d. The PSD development function shall support the development, modification, and maintenance of payload display definition files for ISSA provided PCS.

e. The PSD development function shall perform checks of configuration tables and definition files to ensure proper formatting.

f. The PSD development function shall support the development, modification, and maintenance of payload procedures.

3.7.2.3.2 PAS development.

a. The PAS development function shall support the development, modification, and maintenance of PAS for execution in the Payload MDM and/or the PCS.

3.7.2.3.3 Horizontal testing simulation development.

a. The horizontal testing simulation development function shall support the development, modification, and maintenance of PEP payload interface simulations (i.e. low fidelity local bus simulations) to drive PES, PSD, PAS, and PDS necessary to support horizontal testing at the SVF.

3.7.2.3.4 Flight software modification and maintenance.

a. The flight software modification and maintenance function shall support the modification and maintenance of the PEP CSCI.

b. The flight software modification and maintenance function shall support the modification and maintenance of the RIC software.

c. The flight software modification and maintenance function shall support the modification and maintenance of the EXPRESS Pallet Controller MDM software.

3.7.2.4 Session preparation.

3.7.2.4.1 Pre-build tools.

a. The pre-build tools function shall support the development, modification, and maintenance of scripts.

b. The pre-build tools function shall allow definition of an associated start time for individual script action.

c. The pre-build tools function shall generate scripts that utilize the MCS set of commands and Tier 1 commands.

d. The pre-build tools function shall allow the definition of action execution decisions based on specified logical expressions.

e. The pre-build tools shall generate scripts that have the capability to initiate PTE actions in a predefined sequence.

f. The pre-build tools function shall generate scripts that are capable of initiating PTE actions based on events.

g. The pre-build tools function shall perform syntactic checks of scripts to ensure proper formatting and function.

h. The pre-build tools function shall permit data logging, display and script operational parameters to be specified in the session initialization files.

i. The pre-build tools function shall support creation and modification of session data (e.g. initialization and configuration files).

j. The pre-build tools function shall support creation and modification of the definition of data to be logged during a test session.

k. The pre-build tools function shall allow the specification of the types of data to be logged.

l. The pre-build tools function shall allow the specification of data logging start and stop times.

m. The pre-build tools function shall incorporate mission specific data.

n. The pre-build tools function shall allow definition of start times as absolute simulated time or as a time delay from the previous action.

3.7.2.4.2 Session configuration specification.

a. The session configuration specification function shall provide an interactive capability to specify the hardware and software component configurations required for a session.

b. The session configuration specification function shall generate session configuration files for use in the session software build function.

c. The session configuration specification function shall utilize data from the PSDE CM system or from a specified source in the session configuration specification process.

d. The session configuration specification function shall uniquely identify files and data generated by the specification process.

e. The session configuration specification function shall provide a predefined set of standard session configuration reports.

3.7.2.4.3 Session build.

a. The session build shall produce session loads to be executed in the PTE.

b. The session build shall provide an interactive capability to control the build process.

c. The session build shall provide an interactive capability to specify the build components.

d. The session build shall integrate session data, MCS, VES, and VES application software into a load.

e. The session build shall integrate flight software and associated flight data for the payload MDM, the payload MSD, and the PCS loads.

f. The session build shall integrate RIC software and RIC data into a RIC load.

g. The session build shall utilize build items from the PSDE CM system in the build process or from a specified source.

h. The session build shall uniquely identify files and data generated by the build process.

i. The session build shall be able to produce a set of predefined build reports.

j. The session build shall incorporate mission specific data.

3.7.2.5 Generic experiment simulator builder. The generic experiment builder is a PSIV developed tool that actually builds the code to represent generic payloads. The generic payload simulators are easily built and reconfigurable to represent a variety of generic payloads.

a. The generic experiment simulator builder shall provide the capability to develop generic experiment simulators to be executed in the PTE host computer.

b. The generic experiment simulator builder shall provide an interactive interface for generic experiment simulator development.

3.7.2.6 Session analysis.

a. The session analysis function shall receive logged data from the PSDE CM system.

b. The session analysis function shall provide an interactive capability for authorized personnel to retrieve, archive, display, and delete logged data.

c. The session analysis function shall provide the capability for personnel to interactively design and specify unique data analysis algorithms including arithmetic manipulations and logical manipulations of session data.

d. The session analysis function shall provide trend analysis capabilities.

e. The session analysis function shall provide the capability to produce a set of predefined analysis reports.

f. The session analysis function shall provide the capability for personnel to design report content and format.

g. The session analysis function shall provide performance measurement capabilities.

3.7.2.7 Configuration Management (CM).

a. The CM system shall provide for the management and configuration control of PSIV increment independent hardware and software.

b. The CM system shall provide for the management and configuration control of PED provided PDS, payload software simulations, and data necessary to support payload software verification.

c. The CM system shall provide for the management and configuration control of software and hardware combined for a specific test session.

d. The CM system shall provide for the management and configuration control of software and hardware combined for a specific increment.

e. The CM system shall provide configuration identification of the items placed under CM.

f. The CM system shall control access and privilege to items under CM control.

g. The CM system shall provide release management for items under configuration control.

h. The CM system shall provide for the management and control of informal and internal versions of a configuration item.

i. The CM system shall generate configuration status reports supporting analysis, board reviews, disposition, and status of CM products such as problem/change reports and version/revision status.

j. The CM system shall provide CM library management capabilities in order to maintain documents, source code, software components, and hardware components.

3.7.3 Suitcase Test Environment for Payloads (STEP). The STEP will simulate the command and data interfaces to a U.S. controlled ISPR location. This includes the direct interfaces to the Payload MDM, the Automated Payload Switch (APS), the Payload Ethernet Hub/Gateway (PEHG), and the video system. The STEP will also model indirect interfaces to the ground (uplink and downlink), the ISSA provided PCS, and the High Rate Frame Multiplexer (HRFM). The ISPR Internal Audio and Video interface test capability will be accomplished by connection to a Common Video Interface Unit (CVIU). The CVIU connects to the PED's ISPR and the PED's Video Ground Support Equipment (GSE). The CVIU will be provided to the PED on an as needed basis and is not an integral part of the STEP.

The STEP can be used at the PED's site during development and will have both local and remote capabilities. The local capability refers to testing conducted with an equipment configuration of the STEP, the PED's payload, and possible payload Ground Support Equipment (GSE). The remote capability refers to testing conducted with an equipment configuration of the STEP, the PTE (with its flight FEUs), the PED's payload, and possible payload GSE. The STEP will also be used at the PICF to support final payload interface testing and verification.

a. The STEP shall be available to support the development of PDS and final payload interface verification.

b. The STEP shall be portable.

c. The STEP shall provide a flexible user interface of control and monitoring of a test session.

d. The STEP shall allow the developer to configure a session for his specific bus address, payload parameter definitions, payload command definitions, etc.

e. The STEP shall support the capability to archive, retrieve, and analyze payload data captured during a test session.

f. The STEP shall allow archived data to be stored on removable media.

g. The STEP shall support a remote telecommunication capability for remote integration/testing with the PTE.

h. The STEP shall allow the use of PSIV developed flight products.

i. The STEP shall provide a mass storage capability.

j. The STEP shall allow files to be loaded to the STEP mass storage capability.

k. The STEP shall provide an interface to a PED provided PCS.

l. The STEP shall provide scripting capabilities to support testing sessions.

m. The STEP shall support changes to the ancillary data configuration during the session without interrupting the session.

3.7.3.1 Functional interface testing with the Payload MDM.

a. The STEP shall support testing of data bus protocol on the payload local bus.

b. The STEP shall be capable of sending and receiving data in real time to support the payload local bus test function.

c. The STEP shall support testing of the ground commanding/response function.

d. The STEP shall support testing of the standby and shutdown commanding function.

e. The STEP shall support testing of the transfer of health and status data from the payload.

f. The STEP shall support testing of the transfer of safety data from the payload.

g. The STEP shall support testing of the transfer of ancillary data to the payload.

h. The STEP shall provide the capability to the user to generate and execute test scripts.

i. The STEP shall support monitoring of selected payload parameters.

j. The STEP shall support testing of the file transfer function.

k. The STEP shall support testing of the file storage management function.

3.7.3.2 Functional interface testing with the Payload Ethernet Hub/Gateway (PEHG).

a. The STEP shall support testing of data protocol on the Medium Rate Data Links.

3.7.3.3 Functional interface testing with the APS

a. The STEP shall support testing of data protocol on the High Rate Data Link (HRDL).

3.7.3.4 Functional interface testing with the ISSA provided PCS.

a. The STEP shall support testing of the routing of user payload data to and from crew display devices for command and monitoring functions.

3.7.3.5 STEP remote capability.

a. The STEP remote capability shall transmit and receive data in near real-time, except for high rate data.

b. The STEP remote capability shall allow the transmittal and receipt of command and monitoring data, characteristic of payload local bus data, via the telecommunications path.

c. The STEP remote capability shall allow the transmittal of medium rate data, via the telecommunications path.

d. The STEP remote capability shall allow the post session transmittal of logged high rate data, via the telecommunications path.

e. The STEP remote capability shall be selectable via the control and monitoring portion of the STEP user interface.

f. The STEP remote capability shall identify that the connection is active with the PTE via the STEP user interface.

g. The STEP remote capability shall be capable of being activated and terminated via the user interface.

3.8 Precedence. In the event of conflict of requirements between this specification and other related program documents, the following order of precedence will apply:

(1) United States Ground Segment Specification (SSP 41161)

(2) This specification

(3) Documents referenced in this specification and their references.

(This page intentionally left blank)

4. QUALITY ASSURANCE PROVISIONS

4.1 General. PSIV testing will be performed at MSFC

a. PSIV test methods which will be used for PSIV verification are inspection, analysis, demonstration and test. These methods are defined in the glossary and may be applied singly or in combination to verify compliance.

b. Test conditions will be recorded at the beginning and end of each test.

c. Unless otherwise specified herein, or in attendant approved test procedure, the tests and demonstrations defined herein will be conducted at the following ambient conditions:

Ambient temperature: 70 F +/- 10 F
Relative Humidity: 10 percent to 90 percent, non-condensing
Atmosphere Pressure: 30 +/- 2 inches of mercury.

4.1.1 Responsibility for tests. The contractor will be responsible for performing PSIV testing for acceptance by the customer.

4.1.2 Special tests and examinations. This section is not applicable to this specification.

4.2 Quality conformance Inspection. Appendix II of this specification provides a requirements traceability and verification matrix. This matrix traces PSIV capability requirements to parent requirements in the United States Ground Segment Specification (SSP 41161). This matrix also defines how each PSIV capability requirement will be verified: inspection, demonstration, analysis, or test.

(This page intentionally left blank)

5. PREPARATION FOR DELIVERY

This section is not applicable to this specification.

(This page intentionally left blank)

6. NOTES

The PSIV capability is using the C&DH Option 6 architecture as defined in the Payload Accommodations Handbook (PAH) Vol. 2 United States/Canadian Space Agency (CSA) Pressurized Payloads (SS-HDBK-0001) as its baseline for the development of the ISSA command and data interface compatible environment. This will allow the integration and verification of flight software and data products required to support payload execution including those executing in the Payload MDM, the PCS, the Express RIC, and the Express pallet controller MDM.

The role of the International Partners (IPs) in this document is an issue that surfaced at the 4/18/94 PSIV concept review. This specification will not address flight payload software integration and verification for IP payloads. The PSIV capability is responsible for the flight payload software integration and verification of U.S. payloads manifested in IP modules.

The role of the MBF as the program repository of PES, PAS, PSD, and PDS is an open issue that surfaced at the 4/18/94 PSIV concept review. This issue is currently being worked in the MBF to Ground telecon headed by Rich Robitaille (Rockwell). The specifics of the MBF to PSIV interface are currently being documented in the PSIV to MBF ICD.

Payload display development is an open issue. The roles and responsibilities of MSFC Mission Operations Lab (MOL), PED's, PSIV, etc. are currently being defined and documented. When the PSIV responsibilities pertaining to payload display development are clearly defined, this specification will be updated.

6.1 Definitions.

ANALYSIS

A verification method utilizing techniques and tools such as math models, compilation, similarity assessments, validation of records, etc., to confirm that verification requirements have been satisfied.

DEMONSTRATION

A method of verification denoting the qualitative determination of properties of an end item or component by observation. Demonstration is used with or without special test equipment or instrumentation to verify performance, human engineering features, transportability, and displayed data.

ENVIRONMENT SIMULATOR

A software simulation of some aspect of the space environment. Example: Solar sunrise/sunset.

EXPRESS CONTROLLER SOFTWARE (ECS)

Each EXPRESS rack contains a Rack Interface Controller (RIC). The RIC provides a standard set of data services to EXPRESS payloads. The RIC contains ECS and data tables. For each configuration of an EXPRESS rack only the data tables must be updated to support the unique set of payloads executing in the rack.

INCREMENT

The operational configuration of the ISSA between orbiter berthings. Also, the operational time interval of the ISSA between orbiter berthings.

INSPECTION

A method of verification of physical characteristics that determines compliance with requirements without the use of special laboratory equipment, procedures, test support items, or services. Inspection used standard methods such as visual, gauges, etc., to verify compliance with requirements of construction features, document and drawing compliance, workmanship, physical condition, and service code.

INCREMENT DEPENDENT

Hardware and software specific to a particular increment. For the PSIV capability, this includes the PED provided payload FEUs and/or payload software models, procedures, flight timelines, test scripts, displays, PAS, etc. that are added to the increment independent hardware and software to configure the PTE for an increment.

INCREMENT INDEPENDENT

Hardware and software applicable to all increments. For the PSIV capability, this includes the VES, the MCS, the simulations, and facility equipment that are not modified (i.e. code rewritten) to support a new training increment. Increment-independent system may require configuration (i.e. input parameters changed) to support a new training increment.

MISSION INCREMENT DATA

Data that is specific to a specific increment such as mission sequences, procedures, Ephemeris data, and orbital mechanics data.

PAYLOAD APPLICATION SOFTWARE

Payload-unique software developed to perform specific data acquisition, data reduction, data processing, and data manipulation requirements for the complement of payloads on a given increment. Executes in the Payload MDM with PES. PSIV has budgeted a total of 5000 SLOC per increment for PAS. Similar to SPACELAB Experiment Computer Application Software (ECAS).

PAYLOAD DEVELOPER SOFTWARE

Software developed by the payload experiment developer to execute in the PED's processor(s).

PAYLOAD EXECUTIVE SOFTWARE (PES)

Payload management/support software developed by PG-3 (Boeing-Huntsville). It executes in the Payload MDM. It is designed as payload system software independent of increment payload configurations that utilize payload specific data definitions, data files, procedures, and displays. Similar to SPACELAB Experiment Computer Operating System (ECOS).

PAYLOAD FLIGHT SOFTWARE

All on-board payload software and data supporting payload operations. Payload flight software includes payload system software, payload developer software, EXPRESS controller software, and payload support data.

PAYLOAD OPERATIONS DATA

Payload operations data is the information received by the PSIV from the POIC for use in integration and verification. This data includes mission sequences, procedures, display requirements, and other information relating to the payload complement operations, as required.

PAYLOAD SUPPORT DATA

All of the payload data definitions, data files, displays, and procedures stored and/or executed in station avionics devices that are used to support PES, PAS, PDS, ECS, or EPMACS.

TEST

A method of verification wherein performance requirements are verified by measurement during or after the controlled application of functional and environmental stimuli. These measurements may require the use of laboratory equipment, recorded data, procedures, test support items, or services.

TIER 1 COMMANDS

Commands that are issued from the crew, the ground, or the Command & Control model.

6.2 Acronyms and Abbreviations.

AIS	Automated Information Security
APS	Automated Payload Switch
APM	Attached Pressurized Module
CCSDS	Consultant Committee for Space Data Systems
CCTV	Closed Circuit Television
COTS	Commercial Off The Shelf
COU	Concept of Operation & Utilization
CM	Configuration Management
CSA	Canadian Space Agency
CSCI	Computer Software Configuration Item
CVIU	Common Video Interface Unit
C&DH	Command & Data Handling
C&T	Communication & Tracking
ECAS	Experiment Computer Application Software
ECOS	Experiment Computer Operating System
ECS	EXPRESS Controller Software
EPMACS	EXPRESS Pallet MDM Application Controller Software
EWS	Early Warning System
EXPRESS	EXpedite the PRocessing of Experiments to Space Station

F	Fahrenheit
FEU	Functional Equivalent Unit
GMT	Greenwich Mean Time
GPS	Global Positioning System
GSE	Ground Support Equipment
HRDL	High Rate Data Link
HRFM	High Rate Frame Multiplexer
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IAN	Institutional Area Network
ICD	Interface Control Document
I/O	Input/Output
IP	International Partner
ISPR	International Standard Payload Rack
ISSA	International Space Station Alpha
MBF	Mission Build Facility
MCS	Monitor & Control Station
MDM	Multiplexer/Demultiplexer
MET	Mission Elapsed Time
MIC	Management Information Center
MOL	Mission Operations Lab
MSD	Mass Storage Device
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NSI	NASA Science Internet
PABX	Private Automatic Branch Exchange
PAI	Payload Analytical Integration
PAH	Payload Accommodations Handbook
PAS	Payload Application Software
PCS	Portable Computer System
PDL	Payload Data Library
PDS	Payload Developer Software
PDSS	Payload Data Services System
PED	Payload Experiment Developer
PEGH	Payload Ethernet Hub Gateway
PEP	Payload Executive Processor
PES	Payload Executive Software
PG	Product Group
PIA	Payload Integration Agreement
PICF	Payload Integration & Checkout Facility
PIDS	Prime Item Development Specification
PIMS	Payload Information Management System
POIC	Payload Operations Integration Center
PPS	Payload Planning System
PSCN	Program Support Communication Network
PSD	Payload Support Data

PSDE	Payload Software Integration and Verification Software Development Environment
PSIV	Payload Software Integration and Verification
PTE	Payload Software Integration and Verification Test Environment
PTC	Payload Training Capability
RIC	Rack Interface Controller
STEP	Suitcase Test Environment for Payloads
SRS	Software Requirements Specification
SSTF	Space Station Training Facility
TBD	To Be Determined
VAC	Volts Alternating Current
VES	Verification Executive System

(This page intentionally left blank)

APPENDIX A - REQUIREMENTS TRACEABIILTY/VERIFICATION MATRIX

(This page intentionally left blank)